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PERFORMANCE EVALUATION AND EFFECTIVNESS OF DOUBLE PIPE HEAT EXCHANGE

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ABSTRACT

A heat exchanger is a device, used to transfer thermal energy (enthalpy) at distinctive temperatures and in thermal contact between two or more liquids, between a solid surface and a liquid, or between solid particles and a fluid. In many process industries, heat exchangers are critical engineering tools, as the efficiency and economy of the system largely depend on performance of the exchangers of heat. The present work aims at modeling the Double Pipe Heat Exchanger, comparing parallel and counterflow analysis and efficiency in SOLIDWORKS 2014 and setting up flow simulation in Solidworks by adding boundary conditions, running calculations, inserting surface parameters, using cut plots and stream trajectories to visualize the resulting fluid.

The fluid used at inlet is water and the Materials used are Stainless Steel 321 and Aluminium Alloy 6061. These two materials are used to analyze the Heat Exchanger Performance and compare the Results of these Materials. Double pipe heat exchanger Effectiveness is calculated theoretically by formulas, using NTU method. To calculate both the parallel and counter flow, Logarithmic Mean Temperature Difference is used (LMTD). By using this method, both materials using parallel flow and counter flow simulation is performed and results are analyzed. In simulation of double pipe heat exchanger, Thermal analysis is performed, based on the given boundary conditions and parameters such as Heat transfer Rate, Temperature of both the Fluid and Solid is calculated and all the graphs are plotted based on effectiveness and heat transfer rate. By comparing the simulation results and NTU method, 7.3% difference obtained, and temperature of fluid and solid is more for stainless steel 321 and varies from 342.99 to 343.2, and when compared with aluminum alloy 6061, varies from 340.5 to 342.99. Based on the results of simulation for both the materials the following inferences are made. Heat Transfer Rate for Stainless Steel 321 is more i.e., 33.983, for aluminum it is more 81.58, but it cannot increase more when compared to minimum value of both the materials. So, stainless steel 321 is considered, because the hardness of steel and corrosive properties of the steel.

KEYWORDS: Logarithmic Mean Temperature Difference(LMTD), Stainless Steel 321 & Aluminium Alloy 6061

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Original Article

1. INTRODUCTION

Heat transfer surface differentiates the fluid and they do not mix or break in a perfect world. Such exchangers are designated as instant exchangers recover, or essentially. Through the storage and release of thermal energy through the surface or matrix of the exchanger, exchangers in which intermittent heat exchange exists between hot and cold fluids are referred to as indirect transfer type or fundamentally regenerators. Typically, such exchangers have fluid leakage due to variations in pressure and rotation / valve matrix switching, stream to liquid flow. Examples of heat exchangers are automotive radiators, condensers, shell and tube exchangers, evaporators, cooling towers, and air preheaters. On the off chance that no phase change occurs in any of the fluids of the exchanger, it is referred to here

and there as a sensitive heat exchanger. In many process industries, heat exchangers are important engineering devices, because process efficiency and economy depend primarily on efficiency of heat exchangers. High performance thermal exchangers are therefore much needed. Improving effectiveness can result in a decrease in the size of a fixed size heat exchanger resulting in an increased heat transfer rate, as well as a decrease in the temperature difference between process liquids, allowing for efficient use of thermodynamic accessibility.

1.1 Shell and Tube type Heat Exchanger

Shell and tube heat exchangers consist of a sequence of pipes. The heated or cooled fluid involves one set of these tubes. The second fluid passes over the heated or cooled pipes, so that either the heat is supplied or the necessary heat is absorbed. The bundle of tubes is called a set of tubes and can consist of various types of tubes: plain, longitudinally finned etc. For high-pressure applications, heat exchangers for shells and pipes are typically used. This is because the shell and tube heat exchangers are strong due to their shape.

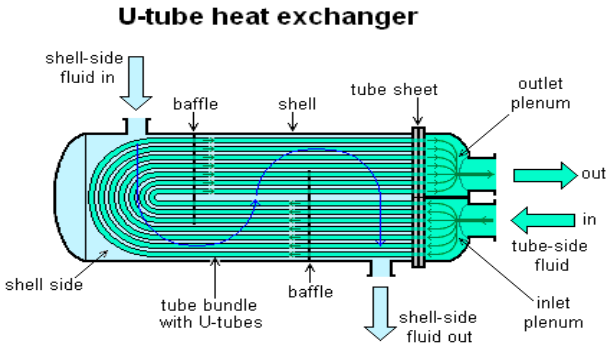


Figure 1.1: Shell and Tube Heat Exchanger.

Pipe Diameter: Using a small pipe length, the heat exchanger is both economical and lightweight. The heat exchanger is more likely to foul up quicker, though, and the small size makes fouling hard to clean mechanically. Larger diameters of tubes can be used to solve the problems of foul and arrest. It is therefore necessary to consider the accessible space, the price and the fouling nature of the liquids

1.2 Double Pipe Heat Exchanger

As shown in figure, this exchanger generally comprises of two concentrated tubes with a simple or finned internal pipe. For the perfect maximum efficiency for the specified surface area, one fluid flows in the internal pipe and the other fluid flows in the annulus between tubes in a counter flow direction. If the application requires an almost constant wall temperature, however, the fluids may flow in a parallel direction of flow. Maybe, this is the easiest temperature exchanger. Division of flow is no issue, and disassembly is very easy to clean.

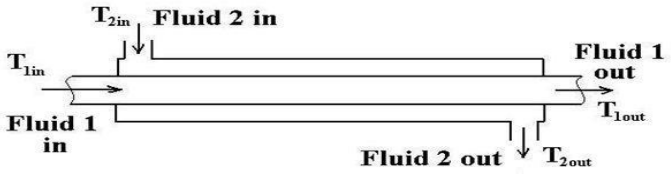


Figure 1.2.1: Double Pipe Heat Exchanger Parallel Flow.

In this double-pipe heat exchanger, a warm process liquid flowing through the inner tube transfers its energy to cooling water, flowing through the exterior tube. The system is in stable condition until conditions change, such as flow speed or inlet temperature. These changes in conditions cause the temperature distribution to change with time, until a stable fresh state is reached. The fresh stable state will be recognized, once the inlet and outlet temperatures are normal and the coolant fluid becomes stable. In fact, temperatures will never be completely stable, but experimentally a fairly stable state can be observed with sufficient changes in inlet temperatures or flow rates.

A hairpin or double pipe heat exchanger's main advantage is that, it can be operated in a true counter flow pattern, which is to provide the biggest overall heat transfer coefficient for the double pipe heat exchanger design. Additionally, hairpin and double tube thermal exchangers can handle high stress and temperatures well. When working in real counter flow, they can work with a temperature cross i.e. where the cold side outlet temperature is higher than the warm side outlet temperature.

1.3 Problem Definition

The classification of present heat exchangers and ii) the sizing of heat exchangers for a particular application is two significant heat exchanger assessment problems. Rating involves determining the rate of warm relocate, altering the warmth of the two liquids, and lowering stress through the heat exchanger. Sizing involves choosing a specific heat exchanger from the currently accessible heat exchanger or determining sizes to design a new heat exchanger taking into account the required heat transfer velocity and allowed pressure drop. When hot and cold fluid inlet and outlet temperatures are known, the LMTD method can be used readily. Only if the outlet temperatures are not known, can the LMTD be used in an iterative scheme. In this case, the NTU method can be used to simplify the analysis.

Thus, designing Heat Exchanger to satisfy client demands for heat transfer and maximum sizes while optimizing weight and pressure losses on both pipe and shell sides is readily evaluated using Solid Works software for flow simulation, so we can choose which material and size are better.

The flow pattern is very essential in the design of a double pipe heat exchanger, usually in any heat exchanger, because we understand that counter flow heat exchanger provides more heat transfer than parallel flow based on the research.

By taking all these considerations into account, we can efficiently and effectively design the double pipe heat exchanger to achieve excellent efficiency and heat transfer rate.

1.4 Objective of the Project

- The aim of the job is to use the SOLIDWORKS2014 software to determine the Double Pipe Heat Exchanger thermal analysis in both Parallel and Counter Flow directions. It can be achieved by developing the Double Pipe Heat Exchanger with assumed circumstances such as Boundary Conditions, the heat exchanger's inlet fluid. The inlet fluid used in my project is water. Double pipe heat exchanger design is performed by shell and tube type, because it has high operating temperature and lower pressure than other kinds. To design Stainless Steel 321 and Aluminum Alloy 6061, I used two materials.
- After developing the heat exchanger, the goal is to figure out the various parameters and to compare the theoretical technique of using software to get the outcomes to standard technique.

Using two materials, Stainless Steel and Aluminum Alloy 6061, the thermal analysis is carried out for the parallel stream and counter to choose which material is best for use.

The heat transfer rate of the two materials is compared and shown in the graph, showing which material is to be used for the shell and tube mass flow inlet values of 0.8kg / s and 0.2kg / s and the inlet temperature of 343.2.

Calculation of efficiency and comparison of efficiency results for both parallel and counter-flow directions of materials.

2. LITERATURE SURVEY

Heat exchangers are used to restore heat between two process liquids in industrial procedures. Although the required heat transfer equations and the pressure drop are accessible in a double pipe heat exchanger, the optimization of the system price is laborious using these equations.

Thus, the heat exchanger's optical design was developed, so that we can readily compare the outcomes using distinct flow models i.e. parallel and counter, and by doing so, we can evaluate which flow is easier by implementing the design-based boundary conditions and temperatures. The most significant variable in Heat Exchanger design is which flow is better and to find effectiveness. Effectiveness is accomplished by using real heat transfer to the highest heat transfer possible.

There are techniques to find out the efficacy of the Double Pipe Heat Exchanger by analytically and conventionally using the formulas. By providing the temperature at the inlet, we can discover the heat flux and outlet temperature. The extensive review of published articles in the open literature on the implementation and design of the double pipe heat exchanger takes up this approach.

Antony luki. A Ganesan and a. M[1] Double pipe heat exchanger comparison of flow analysis and characteristics using enhanced tubes. With dimples strategically situated in a pattern along the pipe of a concentrated tube heat exchanger with the enhanced region on the tube side, enhanced surface was accomplished in this inquiry. Increased surfaces to boost the coefficient of heat transfer, results in increased friction factor. In this study, dimpled tube can be used to alter the inner tube of the double pipe heat exchanger. The heat exchanger for concentrated tubes is designed by Juin Chen a. et.al. The internal tubes consider Nano fluid to be the warm flue gas and the outer tube in this model. Here, the characteristics of alumina nano fluid as the Nanofluid with ethyl glycol as the base fluid is studied here. The heat transfer co-efficient is improved from this design calculation compared to the simple concentrated tube heat exchanger. Similarly, the efficacy of the heat exchanger is 8 percent higher than that of the simple concentrate tube. The theoretical findings indicate that better efficiency is provided by using dimpled tube in concentrated tube heat exchanger. Modeling and analysis is performed using CFD to change the cross sections of the dimple tube, ellipsoidal and spherical forms. The improved dimple pipe is finally compared to the outcomes of the theoretical, analytical and evaluation. It can be concluded from the above literature study that augmented surfaces boost the coefficient of heat transfer with a consequent rise in the factor of friction. Dimpled tube inquiry is used here. The general thermal transfer coefficient is improved from the theoretical calculation and the efficiency of the dimpled tube with concentrated tube thermal exchanger is improved by 8% compared to the concentrated tube thermal exchanger with plain tube.

3. METHOD FOR DESIGNING AND ANALYSIS TO DEVELOP THE WORK

3.1 Introduction

In the past section, based on the literature study, we discovered the appropriate techniques for designing the Double Pipe Heat Exchange. Nevertheless, I want to design the double tube heat exchanger using Solid Works software, based on the specified techniques. Solid Works is one of the easy-to-use design software and the choices in the software are simple to comprehend, so we can readily do the job and compare the outcomes.

The researcher wanted to design the double pipe heat exchanger, using various materials in this section. So, we can compare the values of both components to demonstrate which heat transfer rate of material is higher and which flow is better i.e. (Parallel and Counter). Heat Exchanger design is performed through the use of Solid Works software. Solid Works is mechanical design automation software that uses the familiar graphical user interface of Microsoft Windows. It is an easy-to-learn instrument that allows mechanical developers to sketch thoughts rapidly, experiment with characteristics and sizes, and generate designs and detailed designs.

3.2 Heat Transfer Rate of Double Pipe Heat Exchanger

The rate of heat transfer is a heat exchanger can be expressed as

$$q = U^* A^* \Delta T_m$$

Where ΔT_m is the log mean temperature difference, A is the area; U is the overall heat transfer coefficient

3.2.1 Parallel Flow Heat Exchanger

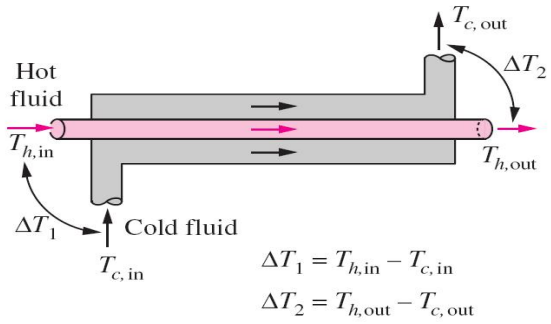
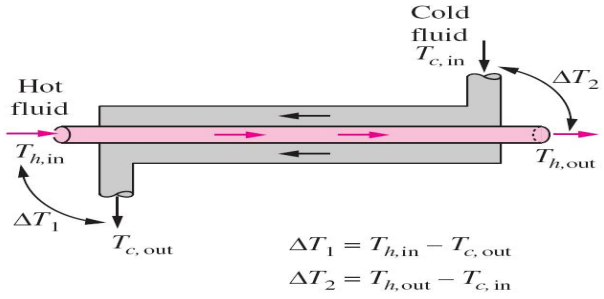


Figure 3.2.1: Double Pipe Heat Exchanger Counter Flow.

3.2.2 Counter Flow Heat Exchanger



(*b*) Counter-flow heat exchangers

Figure 3.2.2: Double Pipe Heat Exchanger Counter Flow.

Transfer heat from one working liquid to another by heat exchangers. Examples of heat exchangers found in nuclear power systems are steam generators, feed water heaters, re heaters and condensers, for example. The heat transfer rate is usually expressed in the form of a heat exchanger

$$Q = U*A*\Delta Tm$$

Where: Q = heat transfer rate

U= overall heat transfer coefficient

A = heat exchanger area m

TΔ= average temperature difference between the fluids.

The general coefficient of heat transfer is a function of the heat exchanger's flow geometry, fluid characteristics and material structure. In particular, the average distinction in temperature between the liquids also depends on the fluid characteristics and the geometry of flow. The design of heat exchangers needs that each of these variables be considered.

3.3 Effectiveness of Double Pipe Heat Exchanger

When only the inlet temperatures are known, the LMTD technique of heat exchanger evaluation is not useful. In this situation, an alternative strategy called the efficacy-NTU method is preferable. A heat exchanger's effectiveness is defined as the ratio of the actual heat transfer rate to the maximum heat transfer rate possible, i.e.

4. FLOW SIMULATION

In the previous section, I could design the double pipe heat exchanger as well as all the heat exchanger's effectiveness, heat transfer rate. I assess the material considered in this chapter, and simulate the flow in both parallel and counter flow directions as well.

4.1 Introduction to Flow Simulation

SolidWorks Flow Simulation is an add-in kit for fluid flow analysis that, Solid Works can use to provide solutions for the full Navier-Stokes equations that govern fluid movement. Solid Works Motion and SolidWorks Simulation are other packages that can be added to SolidWorks.

My task is to determine the thermal analysis of both the parallel and counter flow parts. The present study aims at both the results of the products and compares them using the simulation results. The following general setting steps are included for setting up a Flow Simulation project: choosing the type of evaluation, choosing a fluid and a powerful and setting wall condition and initial and ambient environments.

In addition, a fluid is selected as part of one of the following six categories during the project set-up phase: gas, liquid, non-Newtonian liquid, compressible liquid, true gas or steam. Including thermal conduction in solids, radiation, time-varying flows, gravity and rotation are physical characteristics that can be considered. An assessment of fluid flow using Flow Simulation includes a number of fundamental steps shown in the Flow Chart below.

4.2 Double Pipe Heat Exchanger Flow Simulation

Creation of the project name in the flow simulation bar as "shell and tube heat exchanger"

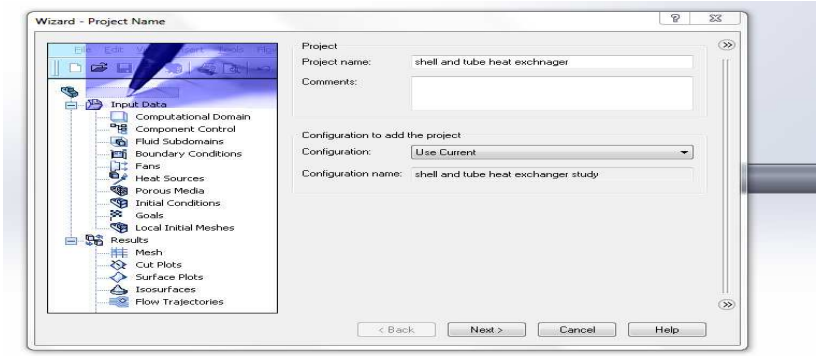


Figure 4.2.1: Flow Simulation.

In the above figure, creating the project name as double pipe heat exchanger on the configuration, we use current and add the project, so that, it can be saved for doing the analysis of the project. The project is added for adding the material and doing easily and comparing all the materials.

4.2.1 Setting Units as SI Units as Shown

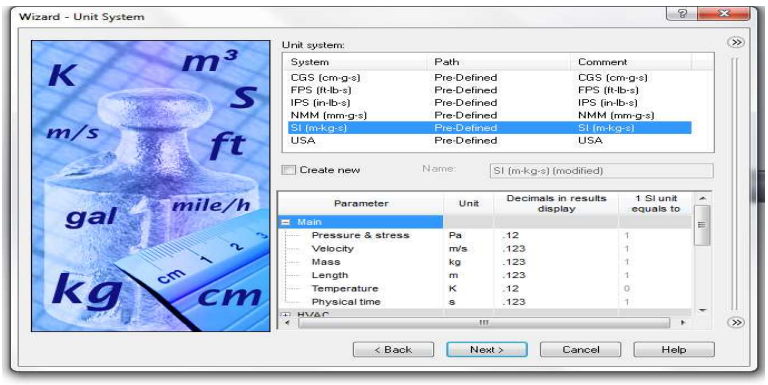


Figure 4.2.2: Setting up of SI Units.

The above figure is to set up units, because units are very important, so I followed standard units based on the given measurements. From the above figure adds the S.I unit on the unit system, so that all follow same units.

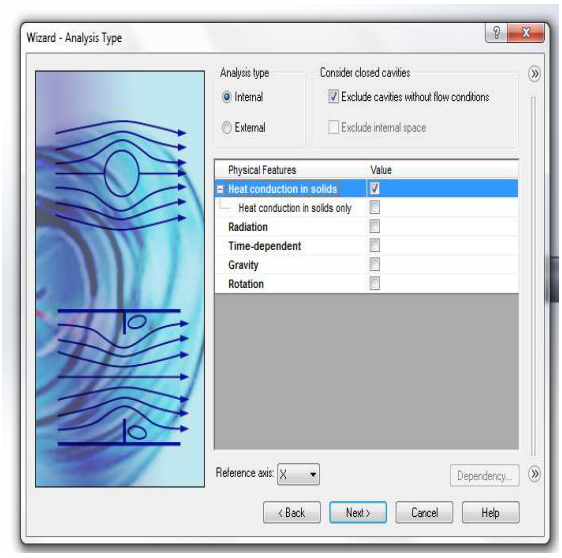


Figure 4.2.3: Using Default Internal Analysis and Checking the Heat Conduction in Solids Box.

This project is based on thermal analysis because in pipe, we can do thermal analysis. By doing static analysis, we can easily find out the parameters such as stress, strain, Heat transfer rate, and Heat Conduction in Solids.

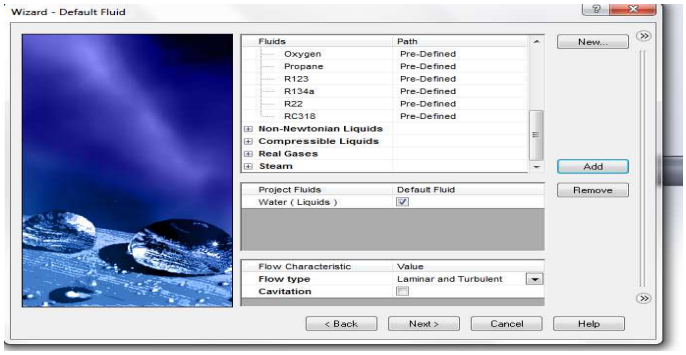


Figure 4.2.4: Adding Water from Liquid as the Project Fluid.

In this project, the inlet material is applied, that is water (Basic Fluid) used for all the materials, so in the software created, new material is added as water.

5. ANALYSIS

In this section, double pipe heat exchanger thermal analysis is performed for both parallel and counter flow, and the results are plotted. For materials, Stainless steel and aluminum alloy 6061 are evaluated and the outcomes are performed using the flow simulation software. In addition, the Double Pipe Heat Exchanger Effectiveness was done using a standard technique and formulas to understand the percentage difference in software process calculation.

The JNTU efficacy–technique was used. Because, we understand only unknown inlet temperature and outlet temperature and mass flow rates and density, and the information book takes viscosity of all materials. The heat transfer rate, fluid temperature, strong temperature in both parallel flow and counter flow are achieved with software by providing all the goals.

The percentage difference or mistake in proportion of both techniques can be obtained by comparing standard method values and simulation values. So we can tell which is the best technique? Form the practical understanding; we understand that the findings of the simulation are relatively good because, the situation of using the software for all tubes neglects the losses. So, we can conclude that the findings of simulation are relatively nice.

5.1 Results for Stainless Steel 321 in both Parallel and Counter Flow

For Counter Flow:

Temperature of the fluid:

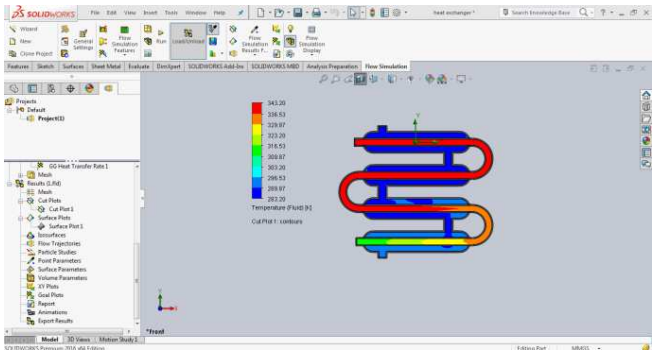


Figure 5.1.1: Max and Min Temperature of the Fluid.

In the above figure, after applying the boundary conditions and inlet temperature, environment pressure, we can calculate Min and Max Temperature of Fluid Min: 283.20, Max: 342.20

5.2 Temperature of Solid

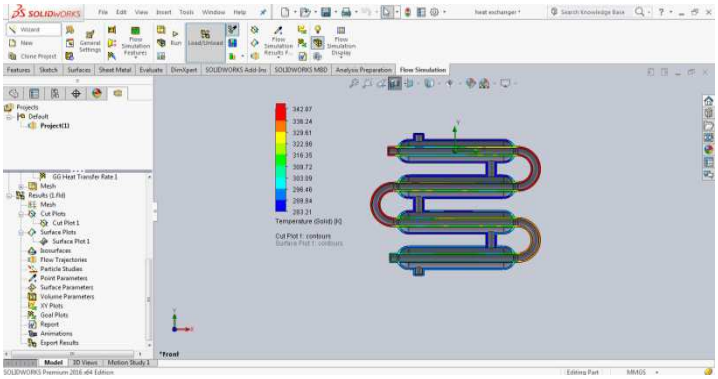


Figure 5.1.2: Max and Min Temperature of Solid.

In the above figure 5.1.2, after giving the boundary conditions and iterations from the Mesh component, applying boundary conditions the Mass of the tube (0.2kg), Pressure 101.325 Pa.

5.3 Heat Flux

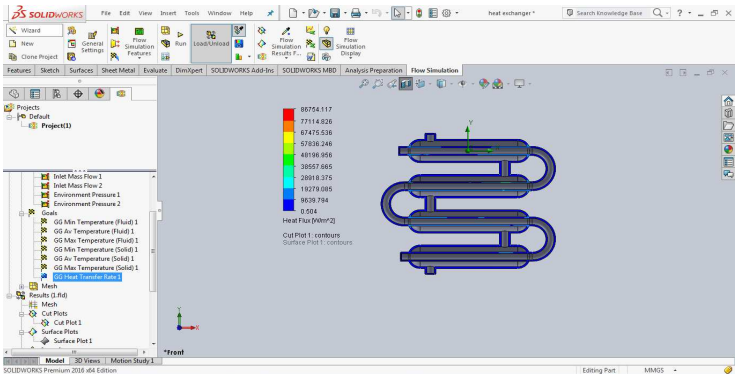


Figure 5.1.3: Max and Min Heat Transfer Rate.

In the above figure, by giving all the same boundary condition after applying the material, stainless steel 321 meant for mutually comparable and contradict stream are analyzed, the Max warm shift is 86754.11

5.4 Goal Plots

Table 5.1.1: Goal Plots of Counter Flow Heat Exchanger

Summary

Goal Name	Unit	Value	Averaged Value	Minimum Value	Maximum Value	Progress [%]	Use In Convergence	Delta	Criteria
GG Min Temperature (Fluid) 1	[K]	283.20	283.20	283.20	283.20	0	Yes	5.37e-006	0
GG Av Temperature (Fluid) 1	[K]	294.75	294.20	293.51	294.77	0	Yes	0.87	0
GG Max Temperature (Fluid) 1	[K]	343.20	343.20	343.20	343.20	0	Yes	5.68e-014	0
GG Min Temperature (Solid) 1	[K]	283.21	283.24	283.21	283.30	0	Yes	0.09	0
GG Av Temperature (Solid) 1	[K]	297.81	295.78	293.74	297.82	0	Yes	2.33	0
GG Max Temperature (Solid) 1	[K]	342.94	342.95	342.94	342.98	0	Yes	0.04	0
GG Heat Transfer Rate 1	[W]	33.983	4.173	-28.504	33.983	0	Yes	23.118	0

In the above table, Goal plots of Counter flow heat exchanger is analyzed by using the solidworks, these results are obtained by using the boundary conditions and the temperatures of inlet materials. After applying the material stainless steel 321, we can get the values of Heat transfer rate, and temperature of both the fluid and solid.

5.5 Temperature of Fluid

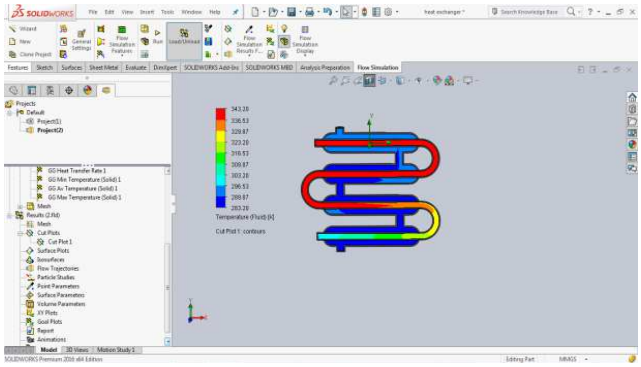


Figure 5.1.4: Max and Min Temperature of Fluid.

In the above figure, after applying the boundary conditions of the shell and tube and environmental pressure, max and min temperature of fluid for parallel flow is obtained.

5.6 Temperature of Solid

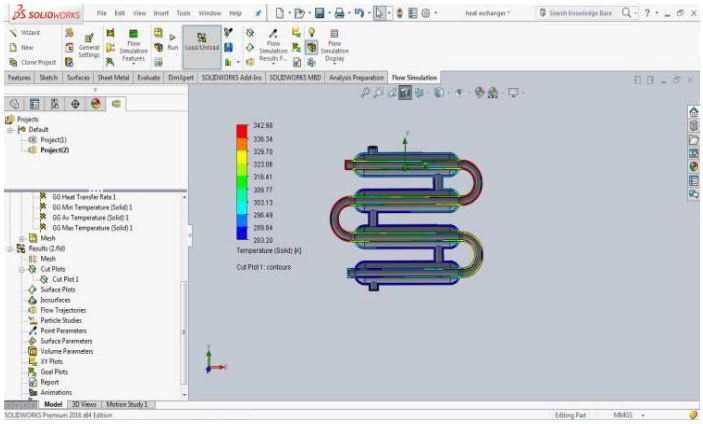


Figure 5.1.5: Max and Min Temperature of Solid.

In the above figure 5.1.5, max and min temperature of solid is obtained after giving goals.

5.7 Heat Flux

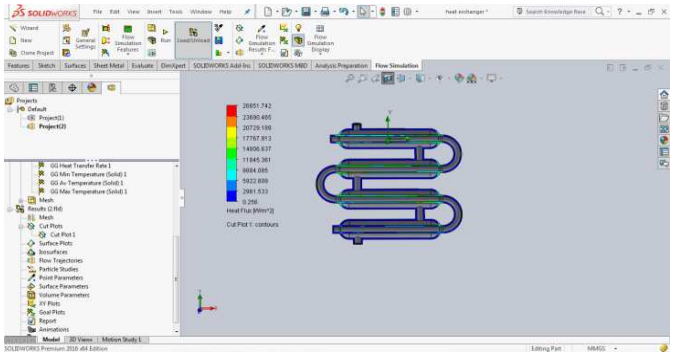


Figure 5.1.6: Max and Min Heat Transfer Rate.

6. RESULTS AND DISCUSSIONS

6.1 Results Comparison of both the Materials based on the given Parameters

Based on the analysis of both the materials in parallel and counter flow directions, the results are obtained by the given parameters, and also Effectiveness in NTU method and flow simulation are compared.

For Stainless Steel 321

The values of Heat Transfer Rate, Temperature of Fluid, Temperature of Solid

Table 6.1.1: Calculation of Parameters by using the Stainless Steel 321 Material

Parameters	Parallel flow		Counter Flow	
	Min value	Max value	Min value	Max value
Heat Transfer	-26.102	8.796	-28.504	33.983
Temperature of fluid	283.20	343.20	283.20	343.20
Temperature of solid	283.27	342.99	297.82	342.98

For Aluminium Alloy 6061

The values of Heat transfer rate, Temperature of fluid, Temperature of solid.

Table 6.1.2: Calculation of Parameters by using Aluminium Alloy 6061

Parameters	Parallel Flow		Counter Flow	
	Min value	Max value	Min value	Max value
Heat Transfer Rate	2.01006	5.0762	72.186	81.582
Temperature of Fluid	283.199	343.2	283.199	343.2
Temperature of Solid	284.791	339.997	284.555	340.5

From the Table 6.1 for Stainless Steel 321 material, Heat transfer rate for counter flow heat exchanger is more when compared to Heat transfer for parallel flow. The maximum values for counter flow heat exchanger is 33.983. 25.87% of counter flow heat transfer is parallel flow. Therefore, counter flow direction is preferred. After applying the boundary conditions of tube, shell at both cold and hot inlet i.e., mass and temperature (0.2kg/s, 343.2) and mass and temperature (0.8kg/s,283.2), we get the maximum and minimum temperature of solid and temperature of fluid.

From the table 6.1 and 6.2, maximum temperature is in Stainless Steel 321 when compared to Aluminium Alloy 60 61. Temperature of the fluid ranges from 283.20 to 342.99 in stainless steel 321 and 283.20 to 340.5 in Aluminium Alloy 6061.

Effectiveness of both the Materials in Parallel and Counter Flow

Figure 7.1.3: Effectiveness of in NTU Method and Flow Simulation for both Materials

Material	Stainless Steel 321		Aluminium Alloy 6061	
	Parallel	counter	Parallel	Counter
NTU Method	0.133	0.140	0.123	0.141
Flow Simulation	0.133	0.140	0.122	0.136

The effectiveness of both the materials are analyzed in NTU Method and flow simulation from the above table for Stainless Steel 321 effectiveness is more in both parallel and counter flow. In the counter flow, stainless steel and aluminum alloy for NTU method is almost equal. On considering both the effectiveness in both parallel and counter flow steel is more effective than aluminum. From the above calculation of two materials based on heat transfer rate, Temperature of fluid and Temperature of solid, all the parameters are more for stainless steel 321 than aluminum alloy 6061. According to the given inlets of both tube and inlet of mass pressure, the results show slight increase in the temperature of both the materials. For aluminum alloy, temperature of the solid and fluid increased less when applied in the boundary conditions, this means, at high temperatures, it will wear and produce low results when compared to stainless steel. Stainless steel is harder than aluminum, it can handle high temperatures, and it is made up of different materials like iron, chromium, nickel, and copper. Chromium is added as an agent to prevent corrosion resistant so no wear and tear problems. Therefore, Heat transfer rate is more for stainless steel.

6.2 Graphs for Both the Material in Parallel and Counter Flow:

The graph between maximum value of both the fluids and solids at the obtained temperature is plotted.

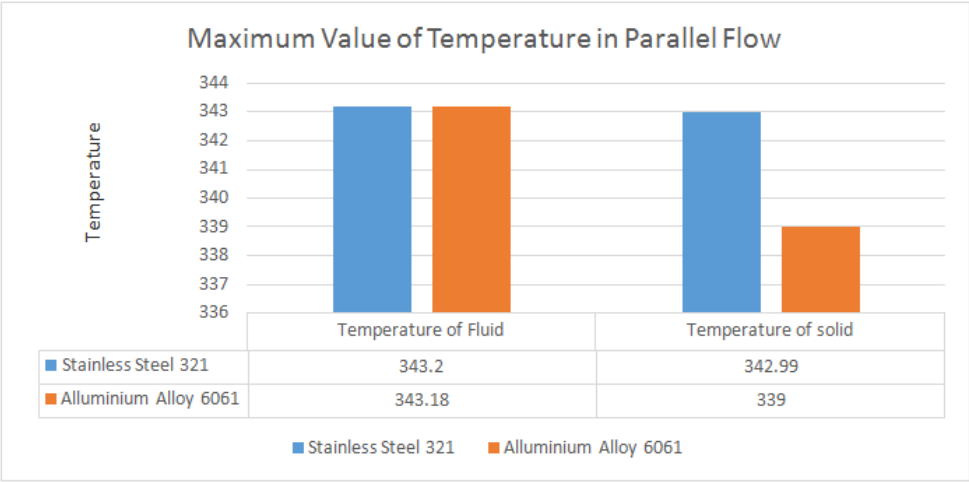


Figure 6.2.1: Graph between Maximum Values of Temperatures in Parallel Flow.

From the above graph, we noticed that the change in the temperature of fluid in stainless steel and temperature of solid in stainless steel is same. There is 1.166% decrease in the value of temperature of solid of aluminium alloy 6061 to the Stainless steel 321.

In the figure 6.2.2, we have drawn the graph between maximum values of temperatures in counter flow; temperature of fluid in counter flow of material stainless steel 321 is same when compared to temperature of solid in same material. There is difference of 1.102% when compared to the temperature of fluid in stainless steel and temperature of solid in aluminium steel.

Compared to the parallel flow, maximum value of temperature in contradict stream is further than that in the analogous stream. The difference between the temperatures of the solid is only the maximum difference in both the parallel and counter flow.

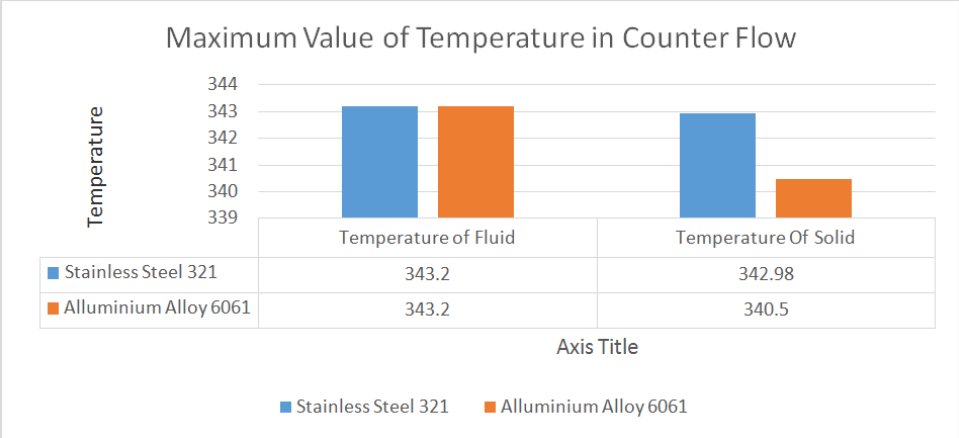


Figure 6.2.2: Graph between Maximum Values of Temperatures in Counter Flow.

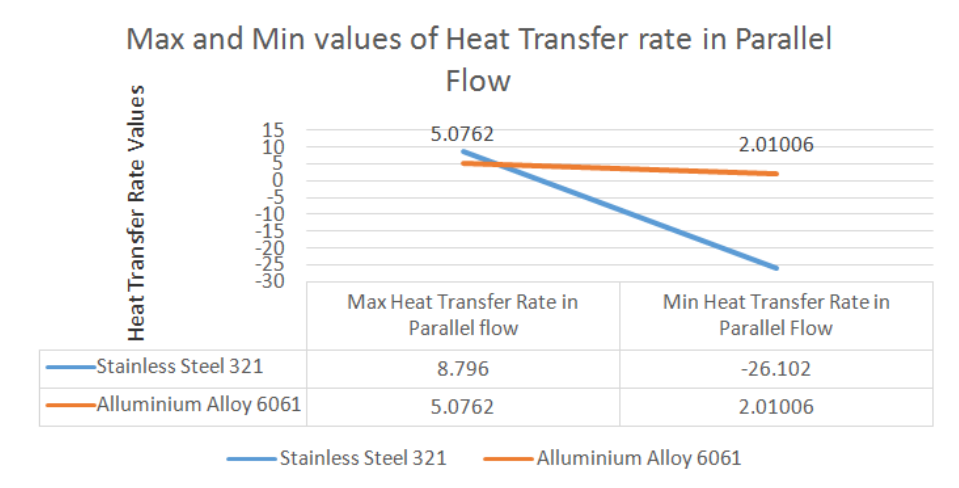


Figure 6.2.3: Graph between Max and Min Values of Heat Transfer in Parallel Flow.

From the above graph, the heat transfer rate for the parallel flow are plotted and the heat transfer rate is more for stainless steel 321, because steel is more harder than aluminium and there are many physical and chemical properties, which is more better than alluminim. The heat transfer rate for stainless steel is 8.796 when compared to the min and max values of both the materials in parallel flow.

7. CONCLUSIONS

The Design and analysis of Double Pipe Heat Exchanger is analyzed by using theoretical calculations and analysis of solid works software 2014. It is concluded from the results that of both the materials, which material shows more Heat transfer

rate and High temperature at the given conditions of the given materials Stainless Steel 321 and Aluminium Alloy 6061. Comparing the flow pattern of two materials, the results show that Counter Flow Heat Exchanger has more Heat Transfer Coefficient than Parallel flow. In the graph, between maximum values of temperature of parallel flow for both the fluids is comparatively same ie.343.2 and the maximum values of temperatures for counter flow for Stainless steel is more by 8.87% than Alluminium Alloy 6061.

Effectiveness of counter flow is more than in parallel flow for both the materials. For stainless steel in parallel flow, effectiveness is 0.123, for counter flow 0.140 and for aluminium alloy 6061; effectiveness is 0.123 for parallel and for counter 0.141. On comparing the both materials in parallel and counter flow, the effectiveness is more for stainless steel as there is 5.26% difference between counter flow and parallel heat exchanger. In the stainless steel, Temperature of both Fluid and Solid is more comparatively to the Temperature of both fluid and solid in Aluminium alloy 6061, and Heat transfer rate for stainless steel, min value decreases to negative value and max value increases to certain extent positive for both counter and parallel flows. In Aluminium alloy 6061, the min value does not go to negative and increases to less extent for maximum values shows in graphs. Therefore, stainless steel 321 is used for better Heat transfer rate and temperatures at Max values. From the graph 6.2.2, there is difference of 1.102% when compared to the temperature of fluid in stainless steel and temperature of solid in aluminium steel.

Scope of Future Work

The shell and tube heat exchanger model and CFD analysis were performed, and the results were compared with the NTU system of performance. A considerable amount of deviation from the actual value to the value obtained in the simulation had been found. The plan has further advancements such as taking into account various types of flows such as cross, parallel and counter flow. And, we have also assumed here that the losses of radiation and convection as zero, whereas in practical situations, they must occur so that this plan can be expanded further along this path. For corrosion damage, it is possible to use different materials that are tougher than stainless steel 321. Using solid works technology, the double pipe heat exchanger has been designed by the researcher. The future work is to use Ansys technology to apply load for the various materials and compare the results.

First, the development and analysis of the double pipe heat exchanger is also carried out in solid works, as the double pipe heat exchanger is more critical for industries such as chemical etc. It takes into account both counterflow and parallel flow, liquid temperature. It is determined by the solid and heat flux. Since the importance of different software of design is through day by day, this project can be implemented in any form of software of design like PRO-E and CATIA. Yet, we chose this technology, because the SOLID WORKS platform is user friendly.

REFERENCES

1. *Antony luki. A, Ganesan. M, "Flow Analysis and Characteristics Comparison of Double Pipe Heat Exchanger Using Enhanced Tubes", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X PP 16-21.*
2. *H. S. Patel, R. N. Makadia, "A Review on Performance Evaluation and CFD Analysis of Double Pipe Heat Exchanger, Indian journal of research- ISSN - 2250-1991 Volume : 2- Issue : 4 - April 2013.*
3. *R. Pachghare, Sumit, S. Kalmegh, Pawan, R. Pachghare Heat Transfer Enhancement in a Double Pipe Heat Exchanger, International Research Journal of Engineering and Technology (IRJET), ISSN – 2395-0056.*

4. *M. Saadoun and Sayed A. E. L Sayed Conducted experiment to enhance heat transfer by determining the detailed by module pressure drop and HTC of turbulence flow inside a circular tube, International Research Journal of Engineering and Technology (IRJET), ISSN – 2395-0072.*

5. *D. P. Sekulic and Tejas M. Ghiwala offered in detail a review on thermal design theory of three fluid heat exchanger, International Journal of Engineering Development and Research © 2014 IJEDR | Volume 2, Issue 2 | ISSN: 2321-9939.*

6. *Qashqaei, A., & Asl, R. G. (2015). Numerical Modeling and Simulation Of Copper Oxide Nanofluids Used In Compact Heat Exchangers. International Journal of Mechanical Engineering, 4 (2), 1, 8.*

7. *N. Sahiti, F. Durst, A. Dewan studied heat transfer enhancement by selecting optimal flow arrangement within heat exchanger, International journal and research ISSN: 4738–4747.*

8. *Sumit. S, Pawan. A, Sawerkar studied heat transfer augmentation is carried out in tube by using recent techniques, IJSRD International Journal for Scientific Research & Development | Vol.2, Issue 11, 2015, ISSN: 2321-0613.*

9. *Ediz Batmaz developed a more generic way of calculating overall heat transfer coefficient, International Journal of Scientific & Engineering Research, Volume 5, Issue 11, November - 2014 1226 ISSN 2229-5518.*

10. *S. K. Saha, P. Langile, S. Loknath In this study they observed the experimentally double pipe heat exchanger with insulated stainless steel twisted tape, international journal of engineering science & advanced technology volume-2, issue-4, 881 –885, ISSN: 2250-3676.*

11. *Wen Lih Chen, Mansoor sidique, majeed alhasmy presented a numerical study on the flows in parallel and counter flow double tube heat exchangers, International journal of Modern Engineering Research, ISSN:2249–6645, Vol. 5 | Iss.3| Mar. 2015 | 42|.*

12. *T. Aseer Brabin, S. Ananth carried out the Heat Transfer, Mass Flow Rate, and Effectiveness of LMTD of a shell and tube heat exchanger, journal of advances in mechanical engineering and science, vol.1(3) 2015, pp.28-40.*

13. *Yunus, M. O. H. A. M. M. E. D., & Alsoufi, M. S. (2015). A statistical analysis of joint strength of dissimilar aluminium alloys formed by friction stir welding using taguchi design approach, anova for the optimization of process parameters. IMPACT: International Journal of Research in Engineering & Technology (IMPACT: IJRET), 3(7), 63-70.*

14. *C. A Zuritz, developed a set of analytical equations for fluid temperatures at any axial location along the heat exchanger for parallel and counter flow configurations and conducted simulation of triple concentric pipe heat exchanger. ISSN (Online) 0000–0000, ISSN (Print) 0000–0000.*

15. *Ebieto, C. E and Eke G. B in his experimental paper the carried out the performance analysis of shell and tube heat exchanger, international journal of innovation research in science engineering and technology, IISN (online: 2318-8753).*

16. *K. S. Bharuka and D. Y. Kasture studied the characteristics of heat transfer in a double pipe helical heat exchanger, IIT Rourkela.*

17. *Vimal Kumar conducted an experiment on tube-in-tube heat exchanger and observed that with the increase in operating pressure in the inner tube, International Journal of Engineering Research and Applications (IJERA), ISSN: 2248-9622.*

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